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Elements and Light Curve of R V Lyræ (Ch. 6915).

By A. Stanley Williams.

$$\text{R.A.} = 19^{h}\ 10^{m}\ 49^{s} \quad \text{Decl.} = +32^{\circ}\ 10'{\cdot}1\ (1855)$$
$$\text{,,} \quad = 19\ 12\ 31 \quad \text{,,} \quad = +32\ 14{\cdot}8\ (1900)$$

Preliminary elements of variation of this Algol-type variable were published in the *Astronomische Nachrichten*, No. 3811, the period being there given as $3^{d}{\cdot}598883$. The minima of this star are rather faint for observation with a 6½-inch aperture, but observations have been made here whenever practicable; and although the results are neither so numerous nor so satisfactory as might be wished, yet it now seems desirable to discuss the results so far obtained, and to derive improved elements of variation, particularly since it is now practicable to connect the more recent observations with an early Harvard College photographic one.

Table I. contains the comparison stars employed and the adopted light-scale. The latter is a somewhat provisional one, as a complete discussion of the results is reserved to the time when more observations are available; but it appears to be quite satisfactory, and it does not seem likely that any material modification will be made hereafter. The magnitudes in the fifth column of the table are based on the assumptions that the magnitude of the star A is 8·61, and the value of a step 0·05 magnitude. The star *f*, it may be mentioned, is just clearly and steadily visible on a clear night in a 6½-inch reflector.

TABLE I.

Comparison Stars and Light-scale.

Star.	B.D. No.	B.D. Mag.	Light.	Adopted Mag.
A	+32°3376	9·2	0·0	8·61
B	+32·3377	9·1	14·2	9·32
C	+32·3380	9·4	26·7	9·94
b	...	...	41·2	10·67
c	...	...	63·6	11·79
d	...	...	63·6	11·79
e	...	...	72·6	12·24
f	...	...	78·2	12·54

The comparison stars are shown in the adjoining little chart based on the B.D. and constructed for 1855. It should be mentioned that the fainter stars have only been inserted by estimation from a photograph, but the positions will probably be sufficiently accurate for the purpose of identification.

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Table II. contains the observed heliocentric Greenwich mean times of minimum.* The last eleven of these have been derived from the visual observations by means of a mean light-curve. The weights in the last column are on a scale ranging from 1 to 5. A weight 5 implies that the observations are numerous, very accordant, and distributed pretty uniformly on either side of the minimum. The time of the observation of 1901 October 7 was derived from a photograph obtained here with a 4·4-inch portrait lens, on the assumptions that the photographic light-curve and the photographic brightness of the variable and of the comparison star *c* respectively are the same as the visual ones. On the photograph the variable is equal in brightness to this star *c*. Particulars of an early Harvard College photograph, showing the variable faint, have been given by Professor E. C. Pickering in H.C.O. Circular, No. 66 (*A.N.* 3833). A preliminary discussion of the observations showed that this photograph must have been taken when the star was increasing in brightness, and the first minimum of the table was assumed to have occurred 3^h 30^m earlier than the time given for the photograph.

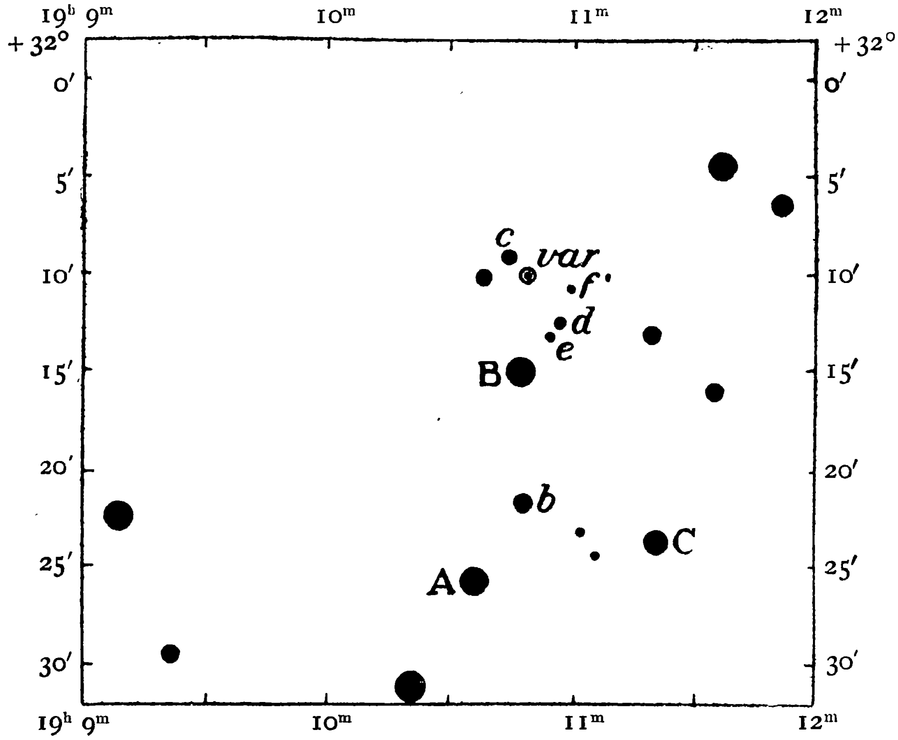

Chart of the Region of *RV Lyræ.*

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* In addition to the minima contained in the table Dr. E. Hartwig observed the star decrease 1·3 mag. between 9^h 22^m and 11^h 19^m (Bamberg mean time) on the night of 1902 Aug. 16 (*A.N.* 3811). The computed time of minimum is $12^h{\cdot}05$ G.M.T. = 12^h 49^m Bamberg mean time.

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TABLE II.

Observed and Computed Times of Minimum.

E.	Observed Minimum.						Computed Minimum.	O−C.	wt.
				h	m	J.D. 241+		m	
−836	1893	July	11	14	44·9	2658·6145	2656·6148	− 0·4	ph.
0	1901	Oct.	7	9	21·8	5665·3901	5665·3897	+ 0·6	ph.
67	1902	June	5	11	45·8	5906·4902	5906·5236	−48·1	1
77		July	11	12	16·9	5942·5117	5942·5137	− 2·9	4
79		,,	18	17	01·9	5949·7096	5949·7117	− 3·0	2
82		,,	29	12	04·8	5960·5034	5960·5088	− 7·8	4
92		Sept.	3	11	45·2	5996·4897	5996·4989	−13·2	4
167	1903	May	31	10	19·5	6266·4302	6266·4249	+ 7·6	3
197		Sept.	16	9	32·3	6374·3974	6374·3953	+ 3·0	3
289	1904	Aug.	12	12	21·3	6705·5148	6705·5045	+14·9	5
297		Sept.	10	7	19·8	6734·3054	6734·2966	+12·7	1
299		Sept.	17	12	10·3	6741·5071	6741·4946	+18·0	1
369	1905	May	27	10	19·3	6993·4301	6993·4255	+ 6·6	2

The following are the fresh elements of variation.

$$\text{Minimum} = 1901 \text{ Oct. } 7,\ 9^{h}\ 21^{m}{\cdot}2\ (\text{G.M.T.}) + 3^{d}\ 14^{h}\ 22^{m}\ 34^{s}{\cdot}7\text{E}$$
$$= \text{J.D. } 2415665{\cdot}3897 + 3^{d}{\cdot}599013\ \text{E}$$

The computed times of minimum and the differences O—C will be found in the last two columns of the above table. These differences are not particularly large with the exception of that for 1902 June 5; but with regard to this it should be remarked that on the night in question only two glimpses of the star could be obtained through nearly continuous cloud, and that since these two glimpses, separated by an interval of 16^{m}, seemed to show that the variable was then decreasing in brightness, whereas it must actually have been increasing, it is probable that one if not both of the observations were more or less affected by cloud.

But the grouping of the plus and minus differences in the table appears to indicate either the existence of systematic error in the observations or else that the adopted period is a little too short. As regards the latter, however, it does not seem permissible to make the time of minimum on 1893 July 11 any earlier than that which has been adopted, so that this early Harvard photograph appears to be conclusive against the adoption of a longer period. The star was assumed to be 3^{h} 30^{m} past minimum at the time of the photograph, and if the time of minimum were put any—even a few minutes—earlier, the star would only have been very slightly fainter than normal. There is, however, a cause which might have produced a systematic

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discordance such as that shown. The mean light curve from which all the times of minimum were derived was constructed from the observations of 1902, and on the assumption that the increasing phase corresponded to the decreasing phase, for nearly all the observations of any value up to that time had been made when the star was decreasing in brightness. But it will be seen from the mean light curve in Table III. that the increasing phase lags a little behind the decreasing one. Now the minima subsequent to 1902 were chiefly observed only in the increasing phase, that of 1904 September 17 being the only one observed during the decreasing phase alone.* Hence it will be evident that the result of using this mean light curve will be to make these subsequent minima, observed chiefly in the increasing phase, a little later than those of 1902, which were observed chiefly only in the decrease. In order to test this point the times of minimum were redetermined by means of the light curve in Table III., the corrections to the times in Table II. being as under :

Date of Minimum.	Correction. m	Date of Minimum.	Correction. m
1902 June 5	+6	1903 May 31	− 5
July 11	+3	Sept. 16	0
„ 18	−4	1904 Aug. 12	− 9
„ 29	−1	Sept. 10	+ 2
Sept. 3	−1	„ 17	−11
		1905 May 27	− 3
Mean	= $+0^{\mathrm{m}}\cdot 6$	Mean	= $-4^{\mathrm{m}}\cdot 3$

The mean correction indicated for the five minima of 1902 is $+0^{\mathrm{m}}\cdot 6$, and that for the six subsequent minima is $-4^{\mathrm{m}}\cdot 3$. Hence there is a difference of about five minutes in the right direction. The whole of the systematic difference shown by Table II. does not appear, however, to be accounted for in this manner, so that it seems possible that the real period may be very slightly longer at present than that adopted. Unfortunately the observations of this variable have been almost a complete failure during the present year, owing to unfavourable weather, so that it does not seem safe to conclude anything more definite at present.

The mean light curve given in Table III. has been derived from 92 *good* observations, all doubtful ones having been rejected. It appears to be quite reliable and satisfactory excepting just at the beginning of the decrease and at the end of the increase, where the observations are at present only few in number, so that the exact form of the curve at these two points is somewhat uncertain.

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* The minimum of 1904 Aug. 12 was observed during both the decrease and the increase.

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TABLE III.

Light Curve of RV Lyræ.

Time.	Brightness Before Min.	Brightness After Min.
h m		
4 00	49·0	50·6
3 50	49·5	52·0
3 40	51·0	53·6
3 30	53·2	55·6
3 20	55·4	57·7
3 10	58·0	59·9
3 00	60·5	62·5
2 50	62·6	64·7
2 40	65·3	67·0
2 30	67·4	69·3
2 20	69·2	71·4
2 10	71·2	73·5
2 00	72·8	75·1
h m		
1 50	74·5	76·7
1 40	76·0	77·9
1 30	77·5	79·0
1 20	78·7	79·9
1 10	79·7	80·7
1 00	80·5	81·2
0 50	81·1	81·6
0 40	81·7	82·0
0 30	82·0	82·1
0 20	82·2	82·2
0 10	82·3	82·3
0 00	82·4	82·4

The brightness of the variable according to the light-scale of Table I. is given for every ten minutes of time before and after minimum in the above table. The normal brightness of the star is 49·0 of the scale, corresponding to 11·06 mag. The minimum brightness is 82·4 = 12·73 mag. There is no stationary period at minimum. The table shows a slight though distinct difference in the form of the curve before and after minimum. The star appears to take a little longer in recovering its light than it did in losing it. The difference is, however, not great, and may perhaps be only subjective.

Hove: 1905 *December* 26.

Elements and Light Curve of VW Cygni (Ch. 7268).

By A. Stanley Williams.

R.A. = $20^{h}\ 09^{m}\ 37^{s}$ Decl. = $+34^{\circ}\ 03'{\cdot}7$ (1855)
" = $20\ \ 11\ \ 21$ " = $+34\ \ 11{\cdot}8$ (1900)

Preliminary elements of variation of this Algol-type variable star have been published in the *Astronomische Nachrichten*, No. 3899, the period being there given as 8·4326 days. The minima of this star are difficult to observe, owing to the long duration of the stationary period (7 hours). In fact I have not